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OE knowledge base

A system that learns through experience

OE-KB is a computer software tool that selects, processes, and analyzes disparate data gathered from various ordnance sites in order to help investigators find ordnance more easily—maybe even pinpoint it. The ultimate goal is to determine a signature, or fingerprint, that would positively identify each type of buried munition.

Performance Capabilities The objective of OE-KB analysis is to reduce the number of excavations by predicting which geophysical anomalies are buried ordnance and which are merely metallic scrap. OE-KB has already demonstrated promising prediction capabilities in various field tests. One blind test resulted in an 85% detection rate. OE-KB also estimates anomaly mass and depth better than current detection and analysis methods. One study concludes that depth estimation accuracy from total magnetometer and gradiometer data is only 20% and size estimation accuracy runs from 15% to 30%, depending on target shape and orientation. OE-KB typically estimates mass and depth with an accuracy of about 80%.

Methodology OE-KB analysis is unique because the system actually learns through "experience," continuously improving its predictive capabilities. Knowledge Base gains experience through its neural network, an analytical tool based on the way neurons in the human brain receive, process, store, and communicate knowledge. Used to solve problems that typically defy formula-based analytical methods, neural networks produce answers based entirely on empirical evidence, or in human terms, through experience.

Synthesizing Data Because maximum values are only one piece of the puzzle, analyses based on such values alone can yield incorrect results. By "learning" the importance of all the instrument readings surrounding an anomaly rather than relying on only the maximum reading, OE-KB can synthesize many variables influencing the geophysical signals of underground objects. Such variables include soil conditions, other nearby objects, object deterioration, material composition, object orientation, instrument-object spatial configuration, and instrument operational conditions.

For example, the tables below show data collected with a dual-coil pulsed induction sensor (Geonics EM-61). The peak (or maximum) values in table 1 tell us that the EM-61 (a pulsed induction sensor) sees three anomalies as very different when they actually have similar mass and depth. Conversely, the peak values in table 2 tell us that the EM-61 sees the three anomalies as very similar when they actually have vastly different depth and mass. Knowledge Base solves the problem of peak values by also analyzing other values and "remembering" and comparing all value relationships associated with a target of a particular mass and depth.

Table 1			
Anomaly ID	Weight (lb)	Depth (in)	Coil 2 Peak (mV)
1	10	6	117
2	10	6	76
3	10	6	37
Table 2			
Anomaly ID	Weight (lb)	Depth (in)	Coil 2 Peak (mV)
4	5.0	6	24.1
5	0.3	2	24.3
6	12.0	12	24.6

Because KB's predictive capabilities depend on experience, the broader the data base, the better OE-KB's analysis. To build a comprehensive data base, Huntsville Center uses its OE-GIS, which holds and manages data from various site investigations, including historical maps, detection instrument readings, and archives search reports. OE-KB taps GIS data, selecting the data it needs for analysis. As the data base grows with information from more site investigations, OE-KB gets "smarter," predicting anomaly locations more and more accurately.